CITY OF FORT WAYNE MASTER UPDATED: 11/16/18

SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

1. GENERAL
	1. DESCRIPTION
		1. Scope:
			1. Contractor shall provide all labor, materials, equipment, and incidentals shown, specified, and required to furnish and install conduit and fittings to form complete, coordinated and grounded raceway systems.

NTS: Retain paragraph “2” below when conduit routings are not detailed on the Drawings. The level of detail may vary with project and Owner requirements; however, detailed routings are usually not included for Work within buildings, but should be included for exterior areas and tanks.

* + - 1. When specific, detailed conduit routings for various systems within buildings and other areas are not be shown on the Drawings, Contractor shall establish routings based on single-line, riser, and interconnection diagrams and other information on the Drawings. Contractor shall provide for the proper installation of conduits in each system.

NTS: Edit conduit types and application below to suit the Project. Coordinate with Plant.

* + - 1. Conduit types and the installation methods shall comply with the following, unless otherwise shown or indicated in the Contract Documents:
				1. Use rigid aluminum conduit for exposed indoor conduit runs in non-corrosive areas.
				2. Use PVC-coated rigid steel for exposed exterior conduit runs in hazardous, wet, and corrosive locations.
				3. Use PVC-coated rigid steel or rigid aluminum conduit for exposed interior conduit runs in hazardous, wet, and corrosive locations.
				4. Use PVC-coated rigid steel conduit for individual conduits direct-buried in the ground.
				5. Use Schedule 40 PVC conduit for concrete-encased duct bank runs.
				6. Use PVC coated rigid steel conduit for transition from duct bank.
				7. Use Schedule 40 PVC conduit for conduit runs embedded in structural concrete slabs. Use PVC coated rigid steel conduit for transition from duct bank.

NTS: Edit paragraph “h” below to suit the project. Coordinate with section 26 29 23, Low-Voltage Variable Frequency Drives, and other “noise sensitive” requirements and edit accordingly. Insert at (--1--) either “PVC-coated rigid steel” or “aluminum” as required. Delete paragraph “g” if not required.

* + - * 1. Use rigid steel conduit for industrial control systems (ICS), system control and data acquisition (SCADA) systems, and communication systems, regardless of the installation. Conduit shall be (--1--) in hazardous, wet, and corrosive locations.
		1. Coordination:
			1. Conduit runs shown are diagrammatic. Coordinate conduit installation with piping, ductwork, light fixtures, and other systems and equipment and locate to avoid interferences.
			2. For conduits to be embedded in concrete slabs, confirm adequate slab thickness and coordinate location of conduits with placement of reinforcing steel, waterstops, expansion joints, and other features of the concrete slab.
		2. Related Sections:

NTS: List below only sections covering products, construction, and equipment specifically identified in this section and specified in another section and directly referenced in this specification. Do not list Administrative and Procedural Division 01 Sections.

* + - 1. Section 31 00 05 Trenching and Earthwork
			2. Section 32 12 16, Asphalt Paving.
			3. Section 26 05 05, General Provisions for Electrical Systems.
			4. Section 26 05 29, Hangers and Supports for Electrical Systems.
			5. Section 26 05 53, Identification for Electrical Systems.
	1. REFERENCES

NTS: Retain applicable standards and add others as required.

* + 1. Standards referenced in this Section are:
			1. AASHTO, Standard Specifications for Highway Bridges.
			2. ANSI C80.1, Standard for Rigid Electrical Steel Conduit (ERSC).
			3. ANSI/NEMA FB1, Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable.
			4. NEMA TC3, Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
			5. UL 514B, Conduit, Tubing, and Cable Fittings.
			6. UL 886, Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.

NTS: Retain applicable regulatory requirements and add others as required.

* + 1. Regulatory Requirements: Comply with the following:
			1. National Electrical Code: Components and installation shall comply with NFPA 70.
			2. NEC Article 344, Rigid Metal Conduit.
			3. NEC Article 350, Liquid-Tight Flexible Metal Conduit.
			4. NEC Article 352, Rigid Nonmetallic Conduit.
			5. NEC Article 358, Electrical Metallic Tubing.
		2. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).
			1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
			2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.
		3. Comply with NECA "Standard of Installation."

NTS: Edit article “1.3” below to suit the Project. DO NOT DELETE (NOT USED) ITEMS.

* 1. SUBMITTALS
		1. Action Submittals: Submit the following:
			1. Product Data
				1. Manufacturer’s catalog cuts and product data for conduit, fittings, and appurtenances.
			2. Shop Drawings
				1. Assembly details of conduit racks and other conduit support systems.
				2. Layout drawings showing proposed routing of exposed conduits, conduits embedded in structural concrete, and conduits directly buried in the ground. Shop Drawings shall show locations of pull and junction boxes and penetrations in walls and floors. Shop Drawings of embedded conduits shall include cross-sections showing thickness of concrete slabs and locations of conduits relative to reinforcing steel, waterstops, and other features of the slab.
			3. Samples (NOT USED)
		2. Informational Submittals: Submit the following:
			1. Certificates (NOT USED)
			2. Delegated Design Submittal (NOT USED)
			3. Test and Evaluation Reports (NOT USED)
			4. Manufacturers’ Instructions
				1. When requested by Engineer, provide copies of manufacturer’s recommendations for handling and installing products.
			5. Source Quality Control Submittals (NOT USED)
			6. Field Quality Control Submittals
				1. When requested by Engineer, provide copies of results of specified Site quality control testing.
			7. Manufacturer Reports (NOT USED)
			8. Sustainable Design Submittals (NOT USED)
			9. Special Procedure Submittals (NOT USED)
			10. Qualifications Statements (NOT USED)
		3. Closeout Submittals. (NOT USED)
			1. Maintenance Contracts (NOT USED)
			2. Operation and Maintenance Data (NOT USED)
			3. Bonds (NOT USED)
			4. Warranty Documentation (NOT USED)
			5. Record Documentation
				1. Show actual routing of exposed and concealed conduit runs in record documents in accordance with Section 01 78 39, Project Record Documents.
			6. Sustainable Design Closeout (NOT USED)
			7. Software (NOT USED)
		4. Maintenance Material Submittals. (NOT USED)
			1. Spare Parts (NOT USED)
			2. Extra Stock Materials (NOT USED)
			3. Tools (NOT USED)
1. PRODUCTS

NTS: Edit the conduit types below to suit the project. Retain applicable paragraphs and delete inapplicable provisions.

* 1. METAL CONDUIT AND TUBING
		1. Rigid Steel Conduit, Elbows, and Couplings:
			1. Material: Rigid, heavy-wall, mild steel, hot-dip galvanized, smooth interior, tapered threads and carefully reamed ends; 3/4-inch NPS minimum size.
			2. Galvanized Rigid Steel Conduit: ANSI C80.1.
		2. PVC-coated Rigid Steel Conduit, Elbows, and Couplings:
			1. Manufacturers: Provide products of one of the following:
				1. Robroy Industries.
				2. No “Or Equal”
			2. Material: Rigid, heavy-wall, mild steel, hot-dip galvanized, smooth urethane interior coating, tapered threads, carefully reamed ends, 3/4-inch NPS minimum size with factory exterior coating of 40-mil thick PVC.
			3. Color: Color of coating shall be the same on all conduit and fittings.
			4. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.
		3. Aluminum Conduit, Elbows, and Couplings:
			1. Material: Rigid, heavy-wall aluminum, smooth interior, tapered threads and carefully reamed ends; 3/4-inch NPS minimum size.
			2. Rigid Aluminum Conduit: ANSI C80.5.
		4. IMC – intermediate conduit shall not be used.
	2. METALLIC FITTINGS
		1. Metallic Conduit Fittings, and Outlet Bodies:
			1. Material and Construction: Cast gray iron alloy, cast malleable iron or aluminum bodies and covers consistent with conduit material. Units shall be threaded type with five full threads. Materials shall comply with ANSI/NEMA FB1 and be listed by UL. Do not use “LB” fittings. Use type “LBD” fittings where use of fittings is unavoidable.
			2. Use: Conduits shall be gasketed and watertight in hazardous, wet, and corrosive locations.
			3. The use of threadless couplings and connectors is prohibited.
		2. PVC-coated Conduit Fittings, and Outlet Bodies:
			1. Material and Construction: Cast gray iron alloy, cast malleable iron bodies and covers with factory coating of 40-mil thick PVC and smooth urethane interior coating. Units shall be threaded type with five full threads. Material shall comply with ANSI/NEMA FB1 and be listed by UL. Do not use “LB” fittings. Use type “LBD” fittings where use of fittings is unavoidable.
			2. Use: Provide PVC-coated or aluminum conduit fittings and outlet bodies in hazardous, wet, and corrosive locations. Fitting material shall be consistent with conduit material.
		3. Conduit Hubs:
			1. Material: Threaded conduit hub, vibration-proof, weatherproof, with captive O-ring seal, zinc metal with insulated throat and bonding screw.
			2. Use: Provide for all conduit terminations to boxes, cabinets, and other enclosures in areas designated as wet locations.
		4. PVC-coated Conduit Hubs:
			1. Manufacturers: Provide products one of the following:
				1. Robroy Industries.
				2. No “Or Equal”
			2. Material: Threaded conduit hub, vibration-proof, weatherproof, with captive O-ring seal, zinc metal with insulated throat and bonding screw, and factory coating of 40-mil thick PVC and smooth urethane interior coating.
			3. Use: Provide for PVC-coated steel or aluminum conduit terminations to boxes, cabinets, and other enclosures in areas designated as corrosive location.
		5. Conduit Bushings and Locknuts:
			1. Insulated Bushings: Malleable iron body with plastic liner. Threaded type with steel clamping screw. Provide with bronze grounding lug, as required.
			2. Locknuts: Steel for sizes 3/4-inch through two-inch diameter and malleable iron for sizes 2.5-inch through four-inch diameter.
			3. Use: Provide for all conduit terminations to boxes, cabinets and other enclosures except threaded type in areas designated as dusty locations.
		6. Thru-wall Seals
			1. For new construction through exterior subsurface walls and exterior concrete walls.
			2. For new construction passing through concrete floors and floor slabs.
			3. For conduits passing through new exterior masonry block walls or through core-drilled holes in existing exterior subsurface walls, exterior concrete walls, floor slabs ,and roof slabs, and for conduits passing through existing interior concrete walls or floors and interior masonry block walls.
				1. Manufacturer: Provide­ one of the following:

Type CSMI sealing bushing at the inside of the structure and Type CSMC sealing bushing at the outside of the structure by O-Z/Gedney.

Or equal.

* 1. NONMETALLIC CONDUIT AND FITTINGS
		1. Non-metallic Conduit and Fittings: Nonmetallic Conduit
			1. Rigid Nonmetallic Polyvinyl Chloride (PVC) Conduit:
				1. NEMA TC 2, Schedule 40 or 80 PVC.Rated for 90 degrees C, complying with UL 514B and 651.
				2. Elbows and Fittings shall comply with NEMA TC3
				3. Match conduit to type of material
				4. Fittings: Form elbows, bodies, terminations, expansions, and fasteners of same material and manufacturer as base conduit. Provide cement by same manufacturer as base conduit.
	2. FLEXIBLE CONDUIT
		1. Flexible Conduit (Non‑hazardous Areas and Class 1, Division 2, Hazardous Areas):
			1. Material: Flexible galvanized steel core with smooth, abrasion-­resistant, liquid‑tight, polyvinyl chloride cover. Continuous copper ground built in for sizes 3/4‑inch through 1.25-inch. Material shall be UL-listed.
		2. Flexible Conduit (Class 1, Group D, Division 1, Hazardous Areas):
			1. Material: Flexible brass inner core with bronze outer braid and protective neoprene plastic coating. Steel, brass, or bronze end fittings. Minimum of 12 inches long.
		3. Flexible Metal Conduit: Zinc-coated steel.
		4. Liquid-tight Flexible Metal Conduit: Flexible steel conduit with PVC jacket.
	3. FLEXIBLE CONDUIT FITTINGS:
		1. Metallic Flexible conduit fittings
			1. Material and Construction:
				1. Malleable iron with cadmium finish. Fittings shall adapt the conduit to standard threaded connections, shall have an inside diameter not less than that of the corresponding standard conduit size and shall be UL listed.
				2. Conduit fittings shall be insulated throat type. Conduit shall be liquid-tight with one piece sealing "O" rings with connectors when entering boxes or enclosures
			2. Use: Provide on flexible conduit in non-hazardous and Class 1, Division 2 hazardous areas.
		2. PVC-Coated Flexible Conduit Fittings:
			1. Material and Construction:
				1. Malleable iron with standard finish and 40-mil PVC exterior coating. Fittings shall adapt the conduit to standard threaded connections, and shall have an inside diameter not less than that of the corresponding standard conduit size.
				2. Conduit fittings shall be insulated throat type. Conduit shall be liquidtight with one piece sealing "O" rings with connectors when entering boxes or enclosures
	4. WIREWAYS
		1. Material: Sheet metal sized and shaped as indicated.
		2. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireway as required for complete system.
		3. Select features where not otherwise indicated, as required to complete wiring system and to comply with NEC.
		4. Wireway Covers:
			1. Hinged type for dry locations.
			2. Bolted cover with gasket for wet locations.
		5. Finish: Manufacturer's standard enamel finish unless other wise noted.
	5. PULL JUNCTION, AND TERMINAL BOXES:
		1. General – Applicable to All Boxes:
			1. Description and Performance Criteria:
				1. Boxes shall be appropriate for each location in accordance with NEMA requirements and as required for area classifications specified in Section 26 05 05, General Provisions for Electrical Systems.
				2. For flush-mounted pullboxes in slabs or pavement potentially subject to vehicular traffic, boxes and covers shall be constructed for H-20 loading in accordance with AASHTO Standard Specifications for Highway Bridges.
			2. Materials: Pull boxes embedded in concrete slabs shall be polymer concrete.
			3. Terminal strips and terminal blocks in terminal boxes shall be mounted on terminal box sub-panels.
			4. Identification: Boxes shall be identified in accordance with Section 26 05 53, Identification for Electrical Systems.
		2. Materials and Construction – Dusty Locations:
			1. Material: NEMA 12 or fiberglass.
			2. Gasket: Oil-resistant gasket.
			3. Access: Lift-off hinges and quick-release latches.

NTS: Edit paragraph “C”, below, to suit the Project.

* + 1. Materials and Construction - Wet, Corrosive, or Hazardous Locations:
			1. Material:
				1. Pull boxes in wet, corrosive, or outdoor areas shall be NEMA 4X stainless steel.
				2. Boxes for areas classified as hazardous locations, where required by NEC, shall be NEMA 7 explosion-proof and comply with UL 886.
				3. In corrosive locations, where the conduit system is PVC-coated, boxes shall be cast metal with factory-applied 40-mil PVC coating, Type 316 stainless steel, or non-metallic thermoplastic or fiberglass reinforced plastic material.
			2. Gasket:
				1. Provide neoprene gaskets for wet and corrosive locations.
				2. Gaskets shall be an approved type designed for the purpose. Improvised gaskets are not acceptable.
			3. Access: Stainless steel cover bolts.
			4. Features:
				1. External mounting lugs.
				2. Drilled and tapped conduit holes.
				3. Boxes where conduits enter building or structure below grade shall have 1/4‑inch drain hole at bottom of the box.
				4. Provide threaded connections for explosion proof boxes.
		2. Terminal Blocks:
			1. Material and Construction:
				1. NEMA-rated nylon modular terminal blocks.
				2. 600-volt rated.
				3. Terminals shall be screwed type with permanently affixed numeric identifiers beside each connection.
				4. Power terminals shall be copper and rated for the circuit ampacity.
	1. ACCESSORIES
		1. Fasteners: To the extent possible, fastener material shall be consistent with conduit material. For PVC-coated rigid steel conduit runs, fasteners shall have factory applied PVC coating or be stainless steel. Fasten raceway systems to supporting structures using the following:
			1. To Wood: Stainless steel screws
			2. To Hollow Masonry Units: Toggle bolts and/or hollow wall anchors shall be stainless steel.
			3. To Brick Masonry: Expansion bolts by Price, or equal shall be stainless steel.
			4. To Concrete: Anchors shall be expansion anchors shall be stainless steel.
			5. To Steel: Beam clamps in accordance with Section 26 05 29, Hangers and Supports for Electrical Systems which shall be stainless steel.
		2. Duct Sealing Compound
			1. Soft, fibrous, slightly tacky, non-hardening sealing compound.
			2. Remains workable at all temperatures.
			3. Compound shall not slump at temperature of 300°F and shall readily adhere to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.
		3. Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit passing through concrete floors, walls, or boxes. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.
		4. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers.
		5. Pipe Sleeves: Provide pipe sleeves of one of following:
			1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from following gauge metal for sleeve diameter noted:
				1. 3 in. and smaller: 20 ga.
				2. 4 in. to 6 in.: 16 ga.
				3. Over 6 in.: 14 ga.
			2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.
			3. Plastic Pipe: Fabricate from Schedule 80 PVC plastic pipe.
	2. FIRE RESISTANT JOINT SEALERS
		1. Two-part, foamed-in-place, silicone sealant formulated for use in through-penetration fire-stopping around cables, conduit, pipes, and duct penetrations through fire-rated walls and floors.
		2. Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with ASTM E 814, by Underwriters' Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.
	3. IDENTIFICATION
		1. Conduit Labels:
			1. Provide conduit labels in accordance with Section 26 05 53, Identification for Electrical Systems.
		2. Warning Tape:
			1. Provide warning tape in accordance with Section 26 05 53, Identification for Electrical Systems.
1. EXECUTION
	1. INSPECTION
		1. Examine conditions under which the Work will be performed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with installation until unsatisfactory conditions are corrected.
	2. INSTALLATION

NTS: Edit below to suit the Project.

* + 1. Supports:
			1. Rigidly support conduits by clamps, hangers, or Unistrut-type channels. Conduit supports and accessories shall be in accordance with Section 26 05 29, Hangers and Supports for Electrical Systems.
			2. Support single conduits by means of one-hole pipe clamps in combination with one-screw back plates, to raise conduits from the support surface. Support multiple runs of conduits on trapeze type hangers.
		2. Fastenings: Fasten raceway systems rigidly and neatly to supporting structures using specified materials. Follow NEC for support spacing.
		3. Exposed Conduit:
			1. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow surface contours as much as practical.
				1. Mount exposed horizontal runs as high above floor as possible, and in no case lower than 7 ft above floors, walkways, or platforms in passage areas.
				2. Run parallel or banked raceways together, on common supports where practical.
				3. Make bends in parallel or banked runs from same center line to make bends parallel. Use factory elbows only where they can be installed parallel; otherwise, provide field bends for parallel raceways.
			2. Where possible, run in groups. Provide conduit racks of suitable width, length, and height, arranged to suit field conditions. Provide support every ten feet, minimum.
			3. Install on structural members in protected locations.
			4. Locate clear of interferences.
			5. Provide six inches of clearance from hot fluid lines and 1/4-inch from walls.
			6. Install vertical runs plumb. Unsecured drop length shall not exceed 12 feet.
			7. Use temporary closures to prevent foreign matter from entering raceway.

NTS: The following conduit embedment criteria is intended for Contractor’s use when conduit embedment is desirable and the conduit routings are not detailed on the drawings. The criteria are based on worst-case structural factors. When embedded conduit routing is included on a project, check with the structural Engineer to determine the actual criteria for the project.

* + 1. Conduit Embedded in Structural Concrete:
			1. Run embedded conduit in structural concrete in center of slabs and walls and above waterstops. Conduit connections shall be made watertight.
			2. Before placing concrete, arrange for observation of conduit installation by RPR or Engineer and make necessary conduit location measurements and provide required information on record documents.
			3. Confirm that concrete thickness is sufficient for embedding the quantity of conduits intended. Unless specifically shown or indicated otherwise, embedded conduits shall be in accordance with the following criteria:
				1. Minimum concrete thickness shall be as follows:

For concrete 16 inches thick and less, minimum concrete thickness shall be 11.5 inches plus the depth of largest conduit assembly. Conduit assembly depth shall be from the top of uppermost conduit to bottom of lowest conduit.

For concrete greater than 16 inches thick, minimum concrete thickness shall be 13.5 inches plus depth of largest conduit assembly.

For concrete at foundation slabs, provide a one inch additional to minimum concrete thicknesses specified.

* + - * 1. Conduit spacing shall be as follows:

Two adjacent conduits shall be separated by center-to-center distance of three times the outer diameter of larger conduit

When conduits cross at a point, conduits may be in direct contact and angle of cross shall be 45 degrees or greater. Conduits may also cross within the vertical spacing of multi-conduit layer assembly.

When conduits cross structural expansion joint, two adjacent conduits shall be separated by center-to-center distance of three times the outer diameter of conduit fitting of the larger conduit

* + 1. Underground Conduits:
			1. Install individual, underground conduits minimum of 36 inches below grade, unless otherwise shown or indicated.
			2. Perform excavation, bedding, backfilling, and surface restoration, including pavement replacement where required, in accordance with Section 31 00 05 Trenching and Earthwork, and Section 32 16 00, Asphalt Paving.
			3. Install traceable warning tape 12 inches below finished grade over buried conduits.
			4. Installation shall be in accordance with requirements of section 26 05 43 Underground Ducts and Raceways for Electrical Systems
		2. Empty Conduits:
			1. Install nylon pull wire in each empty conduit and cap conduits not terminating in boxes with permanent fittings designed for the purpose.
			2. Install two spare 1 in. conduits from top of each flush mounted panelboard to area above ceiling for future use. On flush mounted panelboards located on first and higher level floors, provide two spare 1 in. conduits from bottom of panelboard to ceiling area of floor below for future use.
		3. Field Bends: No indentations. Diameter of conduit shall not vary more than 15 percent at bends.
		4. Joints:
			1. Apply conductive compound to joints before assembly.
			2. Make up joints tight and ground thoroughly.
			3. Use standard tapered pipe threads for conduit and fittings.
			4. Cut conduit ends square and ream to prevent damaging wire and cable.
			5. Use full threaded couplings. Split couplings are not allowed.
			6. Use strap wrenches and vises to install conduit. Replace conduit with wrench marks.
			7. Apply zinc-rich paint to exposed threads and other areas of galvanized conduit system where base metal is exposed.
		5. Terminations:
			1. Install insulated bushings on conduits entering boxes or cabinets, except when threaded hubs are used.
			2. Provide locknuts on both inside and outside of enclosure, except when threaded hubs are used.
			3. Use of bushings in lieu of locknuts is not allowed.
			4. Install conduit hubs on conduits entering boxes or cabinets in wet and corrosive areas.
		6. Moisture Protection:
			1. Plug or cap conduit ends at time of installation to prevent entrance of moisture and foreign materials.
			2. Underground and embedded conduit connections shall be watertight.
			3. Thruwall Seals and Conduit Sealing Bushings: Install for conduits passing through concrete slabs, floors, walls, or concrete block walls.
			4. Drainage: Conduit runs shall be fully drainable. Where possible install conduit runs to drain to one end and away from building. Avoid pockets or depressions in conduit runs.
			5. Seal conduit openings within control and instrumentation panels and distribution equipment with duct sealing compound to provide watertight seal.
			6. Use threaded hubs when entering top of enclosures.
			7. Use sealing type locknuts when entering sides or bottom of enclosures.
		7. Corrosion Protection:

NTS: If conduit curbs are to be required for project, keep section 1 below, otherwise delete.

* + - 1. Conduit Curb:
				1. For conduits routed in concrete slabs or floors and stub-ups through floor, provide 4-inch high concrete curb, extending two inches from outer surface of conduit penetrating floor, to prevent corrosion. For floor-mounted equipment, concrete equipment base shall be in lieu of concrete curb.
				2. Conduit stub-ups shall be 90-degree, PVC-coated, rigid, galvanized steel conduit elbow. PVC-coated elbow shall extend a minimum of 1/2-inch above top of concrete curb or equipment base. Should elbow not reach specified height, provide PVC-coated conduit extension to accommodate specified requirements. Provide coupling or fitting for transition from rigid galvanized steel conduit or PVC conduit in slab to PVC-coated elbow.
				3. For conduits stubbing up and terminating at equipment enclosure mounted on concrete base, provide insulated grounding bushing on PVC-coated rigid steel elbow.
				4. For conduits stubbing up and extending to boxes, cabinets, and other enclosures above the concrete curb in wet and dusty areas, provide conduit coupling/fittings between the PVC-coated rigid steel elbow and rigid steel conduit for transition between the two conduit types.
				5. For conduits stubbing up and extending to boxes, cabinets, and other enclosures above the concrete curb or equipment base in corrosive areas, continue conduit system with PVC-coated rigid steel conduit
			2. Dissimilar Metals:
				1. Prevent occurrence of electrolytic action between dissimilar metals.
				2. Do not use copper products in connection with aluminum, and do not use aluminum in locations subject to drainage of copper compounds on bare aluminum.
				3. Protect Aluminum conduit where in contact with concrete.
		1. Reused Existing Conduits:
			1. Pull rag swab through conduits to remove water and to clean conduit prior to installing new cable.
			2. Repeat swabbing until all foreign material is removed.
			3. Pull mandrel through conduit, if necessary, to remove obstruc­tions.
		2. Core drill for individual conduits passing through existing concrete slabs and walls. Notify Engineer in writing in advance of core drilling. Prior to core drilling, drill sufficient number of small exploratory holes to establish that the area to be core drilled is free of existing embedded conduits. Seal spaces around conduit meeting moisture protection requirements of this section.
		3. Non-metallic Conduit:
			1. Install in accordance with manufacturer’s recommendations.
			2. Provide manufacturer’s recommended adhesives or sealants for watertight connections.
			3. Provide expansion fittings for expansion and contraction to compensate for temperature variations. Fittings shall be watertight and suitable for direct burial.
			4. Use PVC coated rigid steel elbows in concrete encasements and duct banks.
			5. Transition to PVC-coated rigid steel conduit before making turn up to enclosures.
		4. PVC-coated Rigid Steel Conduit:
			1. Install in accordance with manufacturer’s recommendations.
			2. Install with manufacturer’s installation tools to avoid damage to PVC coating.
			3. Repair damaged PVC coating with manufacturer’s recommended touch-up compound.
			4. Use only manufacturer approved threading equipment and tools
		5. Telephone and Signal System Raceways 2 in. Trade Size and Smaller: In addition to above requirements, install in maximum lengths of 150 ft (45 m) and with maximum of two 90° bends or equivalent. Install pull or junction boxes where necessary to comply with these requirements.
		6. Conduit bends
			1. Make bends and offsets so inside diameter is not reduced. Unless otherwise indicated, keep legs of bend in same plane and straight legs of offsets parallel.
			2. Provide NEMA standard conduit bends, except for conduits containing medium voltage cable, fiber optic cable, or conductors requiring large radius bends.
			3. Provide large radius conduit bends for conduits containing 5 kV and 15 kV cables as follows:

|  |  |
| --- | --- |
| Conduit Trade Size | Bend Radius |
| 2 in. - 2-1/2 in. | 36 in. |
| 3 in. - 4 in. | 48 in. |
| 5 in. | 48 in. |

* + - 1. Where physical limitations do not permit use of above, conduit bends with radius of at 8 times diameter of largest cable passing through conduit may be used.
		1. Identify conduits, including spares, in accordance with Section 26 05 53, Identification for Electrical Systems.
		2. Vertical Conductor Supports: Install simultaneously with installation of conductors.
		3. Sleeves: Install in concrete slabs and walls and other fire-rated floors and walls for raceways and cable installations. For sleeves through fire rated-wall or floor construction, apply UL listed firestopping sealant in gaps between sleeves and enclosed conduits and cables.
		4. Conduit Seals: Install seals for conduit penetrations of slabs below grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.
		5. Conduit extending through roof shall be sealed and integrated into the roofing system and made water tight.
	1. FLEXIBLE CONDUIT INSTALLATION
		1. Use maximum of 6 ft (1830 mm) of flexible conduit for recessed and semi-recessed lighting fixtures.
		2. Install at motors, transformers, field instruments, and equipment subject to vibration or require movement for maintenance purposes. Provide necessary reducer where equipment furnished cannot accept 3/4 inch diameter flexible conduit. Limit flexible conduit length to three feet maximum.
		3. Use liquidtight flexible conduit in wet or damp locations.
		4. Use approved flexible connections in hazardous locations.
		5. Install separate ground conductor inside flexible conduit connections.
	2. PULL JUNCTION AND TERMINAL BOXES INSTALLATION

NTS: Number the boxes on the drawings when required.

* + 1. Mount boxes so that sufficient access and working space is provided and maintain clearance of not less than 1/4-inch from walls.
		2. Securely fasten boxes to walls or other structural surfaces on which boxes are mounted. Provide independent supports that comply with Section 26 05 29, Hangers and Supports for Electrical Systems, where boxes will not be mounted on walls or other structural surface.
		3. Install pull boxes where shown or indicated, and provide pull boxes where one or more of the following conditions exist:
			1. Conduit runs containing more than three 90-degree bends.
			2. Conduit runs exceeding 200 feet in length.
		4. Provide removable, flame-retardant, insulating cable supports in boxes with any dimension exceeding three feet.
		5. Field-apply PVC touch-up to scratched PVC boxes damaged during installa­tion. Touch-up work shall be in accordance with manufacturer’s recommendations and instructions.
		6. Size junction, pull, and terminal boxes in accordance with NEC Article 314 and other Laws and Regulations.
		7. Provide terminal blocks in boxes where shown and where cable terminations or splices are required.
		8. Do not locate boxes on handrails, unless directed by Engineer.
	1. FITTINGS
		1. Install raceway sealing fittings according to manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL-listed sealing compound. Install raceway sealing fittings at following points and elsewhere as indicated:
			1. Where conduits enter or leave hazardous locations.
			2. Where conduits pass from warm locations to cold locations, such as boundaries of refrigerated spaces and air-conditioned spaces.
			3. Where otherwise required by NEC.
		2. Use raceway fittings compatible with raceway and suitable for use and location. For GRS use threaded galvanized rigid steel conduit fittings, except as otherwise indicated.
		3. Install automatic breather drain fittings according to manufacturer’s written instructions. Locate fittings to drain conduit system and prevent condensate from entering device enclosures. Install automatic breather drain fittings at following points and elsewhere as indicated.
			1. Where vertical seals are installed.
			2. Low points in conduit system.
			3. Below field instruments at junction of flexible and rigid conduit.
			4. Where otherwise required by NEC.
		4. Install wall entrance seal as dictated by application where conduits pass through foundation walls below grade.
		5. Install conduit expansion fittings complete with bonding jumper in following locations.
			1. Conduit runs crossing structural expansion joint.
			2. Conduit runs attached to 2 separate structures.
			3. Conduit runs where movement perpendicular to axis of conduit may be encountered.
		6. Where conduit passes from inside of building to outdoors, it shall be firmly packed at fitting nearest wall line with Johns-Manville Duxseal to depth of at least 1 in. after wires and cables are pulled in; or, if conduit enters directly into equipment, it shall be fitted with seal and drain fitting to prevent water entering equipment.
	2. GROUNDING
		1. Ground in accordance with Section 26 05 26.
		2. Provide grounding connections for raceway, boxes, and components as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals according to torques requirements specified in UL 486A.
	3. PROTECTION
		1. Provide final protection and maintain conditions, in manner acceptable to manufacturer and Installer, to ensure that coatings, finishes, and cabinets are without damage or deterioration at Substantial Completion.
			1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
			2. Repair damage to PVC or paint finishes with matching touch-up coating recommended by manufacturer.
	4. CLEANING
		1. Upon completion of installation of system, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.
	5. FIELD QUALITY CONTROL
		1. Site Tests:
			1. Test conduits by pulling through each conduit a cylindrical mandrel with length not less than two pipe inside diameters, having an outside diameter equal to 90 percent of conduit’s inside diameter.
			2. Maintain a record, by number, of all conduits successfully tested.
			3. Repair or replace conduits that do not successfully pass testing, and re-test.

+ + END OF SECTION + +